

WHAT IS CLAIMED IS:

1. A method of continuously manufacturing a plurality of phase shift mask blanks each having at least a phase shift film on a transparent substrate, said method comprising a step of:

using a sputtering method to continuously form the phase shift film on the transparent substrate,

wherein a dispersion of a phase angle of the phase shift film among said plurality of blanks is within  $\pm 2^\circ$ .

2. A method of continuously manufacturing a plurality of halftone phase shift mask blanks each having a light semi-transmission film on a transparent substrate, said method comprising a step of:

using a sputtering method to continuously form the light semi-transmission film on the transparent substrate,

wherein dispersions of a phase angle and a transmittance of the light semi-transmission film among said plurality of halftone phase shift mask blanks are within  $\pm 2^\circ$  and within  $\pm 4\%$ , respectively.

3. A method of continuously manufacturing a plurality of photo mask blanks each having at least a thin film for forming a pattern on a transparent substrate, said method comprising a step of:

using a sputtering method to continuously form said

thin film on said transparent substrate,

wherein said step of using the sputtering method to continuously form said thin film on said transparent substrate comprises steps of: successively subjecting a plurality of substrates to a series of processes of supplying the transparent substrate into a sputtering chamber, forming the thin film for forming the pattern in said sputtering chamber, and discharging the transparent substrate with the film formed thereon from said sputtering chamber; and supplying and discharging the transparent substrate at a constant interval in order to set a film formation time to be constant among the plurality of blanks, and

at least first to fifth photo mask blanks after start of film formation are excluded from the photo mask blanks obtained in said step.

4. The manufacturing method according to claim 3 wherein said thin film for forming the pattern is a phase shift film, and said photo mask blank is a phase shift mask blank.

5. The manufacturing method according to claim 3 wherein said thin film for forming the pattern is a light semi-transmission phase shift film, and said photo mask blank is a halftone phase shift mask blank.

6. A manufacturing method of a photo mask blank having a thin film for forming at least a pattern on a transparent substrate, said method comprising steps of:

rotating said substrate; sputtering a target  
5 disposed opposite to a position whose center axis deviates from a center axis of said substrate; and forming said thin film.

7. The manufacturing method according to claim 6  
10 wherein the target and the substrate are disposed so that opposite surfaces of said substrate and the target form a predetermined angle therebetween.

8. The manufacturing method according to claim 6  
15 wherein the step of forming the film comprises a step of rotating the transparent substrate integer times between start of film formation and end of the film formation.

9. The manufacturing method according to claim 1  
20 wherein said thin film for forming the pattern is a phase shift film, and said photo mask blank is a phase shift mask blank.

10. The manufacturing method according to claim 2  
25 wherein said thin film for forming the pattern is a phase shift film, and said photo mask blank is a phase shift mask blank.

11. The manufacturing method according to claim 3 wherein said thin film for forming the pattern is a phase shift film, and said photo mask blank is a phase shift mask blank.

12. The manufacturing method according to claim 6 wherein said thin film for forming the pattern is a phase shift film, and said photo mask blank is a phase shift mask blank.

13. The manufacturing method according to claim 9 wherein a dispersion of a phase angle of said phase shift film in a plane is within  $\pm 2^\circ$ .

14. The manufacturing method according to claim 6 wherein said thin film for forming the pattern is a light semi-transmission phase shift film, and said photo mask blank is a halftone phase shift mask blank.

15. The manufacturing method according to claim 14 wherein a dispersion of a phase angle of said light semi-transmission phase shift film in a plane is within  $\pm 2^\circ$  and a dispersion of a transmittance in the plane is within  $\pm 4\%$ .

16. The manufacturing method according to claim 14 wherein said light semi-transmission phase shift film is

formed by sputtering the target formed of a metal and silicon in an atmosphere containing nitrogen, contains the metal, silicon and nitrogen as main constituting components, and is formed so that a content of nitrogen in said light  
5 semi-transmission phase shift film is larger than a content of silicon.

10 17. A photo mask manufactured by patterning the thin film in the photo mask blank according to claim 1.

18. A photo mask manufactured by patterning the thin film in the photo mask blank according to claim 2.

15 19. A photo mask manufactured by patterning the thin film in the photo mask blank according to claim 3.

20 20. A photo mask manufactured by patterning the thin film in the photo mask blank according to claim 6.

21. A pattern transfer method of using the photo mask according to claim 17 to transfer a pattern.

22. A manufacturing apparatus of a photo mask blank, comprising at least: a load lock mechanism for introducing  
25 substrates one by one; a substrate conveying mechanism for introducing the substrates one by one to a sputtering chamber from a load lock chamber at a constant interval; the

sputtering chamber for forming a film on the substrate; and an unload lock mechanism for discharging the substrates one by one from the sputtering chamber.

5           23. A manufacturing apparatus of a photo mask blank, comprising: a substrate laying base having a rotation mechanism; and a target disposed opposite to a position whose center axis deviates from a center axis of a substrate.

10           24. The manufacturing apparatus according to claim 23 wherein the target and the substrate are disposed so that opposite surfaces of said substrate and the target form a predetermined angle therebetween.

15           25. The manufacturing apparatus of the halftone phase shift mask blank according to claim 22, further comprising: means for detecting a rotation position of the substrate; and means for turning OFF electric discharge (ending film formation) when the substrate rotated integer  
20 times after turning ON the electric discharge (starting the film formation) is allowed to reach the same rotation angle position as a rotation angle position for turning ON the electric discharge.